

REMARKS

In section 2 of the Office Action, the Examiner objected to claims 3, 5, 10, 12, 28-30, and 32.

Appropriate amendments have been made to overcome the Examiner's objections.

In section 4 of the Office Action, the Examiner rejected claims 1 and 2 under 35 U.S.C. §103(a) as being unpatentable over the Behrens patent in view of the Nakamura patent.

Independent claim 1 is directed to an apparatus having a non-ferromagnetic compressor wheel of a turbocharger, a permanent magnet, and at least one magnetoresistor. The non-ferromagnetic compressor wheel has fins. The permanent magnet is positioned so as to induce eddy currents on the fins. The at least one magnetoresistor is positioned with respect to the non-ferromagnetic compressor wheel and the permanent magnet so as to be magnetically biased by the permanent magnet and so as to sense rotation of the non-ferromagnetic compressor wheel.

The Behrens patent discloses in Figure 1 a housing 1 of a turbocharger. The housing 1 has a non-magnetic housing wall 2. Aluminum compressor blades 6 rotate within the housing 1 on one side of the housing

wall 2. A rod magnet 9 and an induction coil 10 around the rod magnet 9 are located on the other side of the housing wall 2.

The rod magnet 9 produces field lines that impinge at a right angle on the compressor blades 6. Currents are induced in the compressor blades 6 as they move across the field lines. These induced currents produce a secondary magnetic field that counteracts or damps the magnetic field produced by the rod magnet 9 and induces a current in the induction coil 10. This current induced in the induction coil 10 can be used to indicate the rotational speed of the turbocharger.

As can be seen, the Behrens patent does not disclose the use of at least one magnetoresistor that is magnetically biased by the permanent magnet and that senses rotation of the compressor wheel. Accordingly, the Examiner has relied on the Nakamura patent.

The Nakamura patent discloses a magnetic sensor 71 in Figures 15 and 16. A rotating member 72 of the magnetic sensor 71 has magnetic elements 73 distributed about on its outer surface 72a. A magnetic sensor 80 includes magnetoresistive elements 81 and 82 and a magnet M1. The magnet M1 applies a bias magnetic field to the magnetoresistive elements 81 and 82. Each time the

rotating member 72 is rotated by one turn, a plurality of periods of a pseudo sawtooth wave is output, where the number of periods is the same as the number of the magnetic elements 73. Accordingly, the magnetic sensor device 71 is able to detect a rotation angle.

The Examiner asserts that it would have been obvious to use the magnetoresistive elements 81 and 82 in place of the induction coil 10 disclosed in the Behrens patent. However, the Examiner does not offer any valid argument as to why such a rearrangement of the apparatus disclosed in the Behrens would have been suggested to one of ordinary skill in the art.

The Examiner does assert that the arrangement disclosed in the Nakamura patent would offer high accuracy to the arrangement disclosed in the Behrens patent. However, the Examiner has not shown that the accuracy of the arrangement disclosed in the Behrens patent would be benefited by the arrangement disclosed in the Nakamura patent.

Moreover, the accuracy of determining rotational angle as disclosed in the Nakamura patent is dependent on the number of magnetic elements 73 mounted on the rotating member 72. Since there are probably more blades on a compressor wheel than there are magnetic

elements 73 shown in the Nakamura patent, the arrangement disclosed in the Behrens patent would not benefit from higher accuracy.

Accordingly, the suggestion offered by the Examiner is not valid and the Examiner has not made out a prima facie case of obviousness with respect to independent claim 1. Therefore, independent claim 1 is not unpatentable over the Behrens patent in view of the Nakamura patent.

Furthermore, there is no suggestion in either the Behrens patent or the Nakamura patent that magnetoresistors can be used to sense the eddy currents generated by the blades of a compressor wheel passing by a permanent magnet. The Behrens patent discloses the use of a coil to sense eddy currents, and the Nakamura patent discloses the use of magnetoresistors to sense magnetic elements.

Therefore, for this reason also, independent claim 1 is not unpatentable over the Behrens patent in view of the Nakamura patent.

Because independent claim 1 is not unpatentable over the Behrens patent in view of the Nakamura patent, dependent claim 2 is likewise not unpatentable over the Behrens patent in view of the Nakamura patent.

In section 5 of the Office Action, the Examiner rejected claims 3 and 4 under 35 U.S.C. §103(a) as being unpatentable over the Behrens patent in view of the Nakamura patent and further in view of the Cila patent.

The Cila patent discloses a magnetic pick up 10 that includes a hexagonal housing 12 attached to a threaded connector stud 14 at one end and a threaded hollow stud 16 at its other end. The threaded hollow stud 16 contains a permanent magnet 22 having a pair of magnetoresistors 26 and 28 at its tip coupled to leads 28 and 29 for connection to an electrical circuit within the housing 12. The magnetoresistors 26 and 28 detect ferromagnetic gear teeth 32 as the gear teeth 32 pass by the magnetoresistors 26 and 28. The threaded hollow stud 16 and a lock nut 18 are used to mount the magnetic pick up to a support.

As discussed above, there is no suggestion in either the Behrens patent or the Nakamura patent that magnetoresistors can be used to sense the eddy currents generated by the blades of a compressor wheel passing by a permanent magnet. The Behrens patent discloses the use of a coil to sense eddy currents, and the Nakamura patent discloses the use of magnetoresistors to sense magnetic elements.

Similarly, there is no suggestion in the Cila patent that magnetoresistors can be used to sense the eddy currents generated by the blades of a compressor wheel passing by a permanent magnet. The Cila patent discloses the use of magnetoresistors to sense magnetic gear teeth.

Therefore, independent claim 1 is not unpatentable over the Behrens patent in view of the Nakamura patent and further in view of the Cila patent.

Because independent claim 1 is not unpatentable over the Behrens patent in view of the Nakamura patent and further in view of the Cila patent, dependent claims 3 and 4 are likewise not unpatentable over the Behrens patent in view of the Nakamura patent and further in view of the Cila patent.

In section 6 of the Office Action, the Examiner rejected claims 5-7 under 35 U.S.C. §103(a) as being unpatentable over the Behrens patent in view of the Nakamura patent and further in view of the Takizawa patent.

The Takizawa patent discloses a wheel rotation detecting device having a hub 4 with a flange 10. A wheel and a disk rotor of a brake are fixed to a flange 10. An outside inner ring raceway 7 is formed on the

outer periphery of the hub 4, and an inside inner ring raceway 7 is formed in an inner ring 5 fixed to a stepped portion 16 provided in the hub 4. An outer ring 1 includes a double row of outer ring raceways 6, and balls 8 are interposed between the outer ring raceways 6 and the inner ring raceways 7 so that a rotary ring 3 that includes the hub 4 is rotatably supported by the outer ring 1.

An encoder 13 is supported on the hub 4. A sensor unit 20 is supported on the outer ring 1. The sensor unit 20 can be fixed to the outer ring 1 by screwing a flange 22 formed in the upper end of the sensor unit 20 to the outer ring 1. The sensor unit 20 includes a rotation detecting sensor 25 and a temperature sensor 26. The rotation detecting sensor 25 comprises a magnetic detection element 27, a permanent magnet 28, and a waveform shaping circuit 29. The magnetic detection element 27 can be a magnetoresistor. The temperature sensor 26 detects the temperature of the space 12 within which the balls 8 are disposed.

The encoder 13 is formed of a magnetic metal material having gear-shaped portions that cause the sensed magnetic characteristics to vary alternately and at regular intervals with respect to the circumferential

direction. Accordingly, the rotation detecting sensor 25 detects the rotation speed and/or rotation number of the wheel attached to the hub 4 by detecting these varying magnetic characteristics.

Figure 3 of the Takizawa patent shows a sensor unit 20a having a vibration sensor 32 in addition to the magnetic detection element 27, the permanent magnet 28, and the waveform shaping circuit 29. The vibration sensor 32 is supported on a substrate 33 along with a signal processing circuit 35.

As in the case of the rejections noted above, there is no suggestion in the Takizawa patent that magnetoresistors can be used to sense the eddy currents generated by the blades of a compressor wheel passing by a permanent magnet. The Takizawa patent, like the Cila patent, merely discloses the use of magnetoresistors to sense magnetic gear teeth formed by the encoder 13.

Therefore, independent claim 1 is not unpatentable over the Behrens patent in view of the Nakamura patent and further in view of the Takizawa patent.

Because independent claim 1 is not unpatentable over the Behrens patent in view of the Nakamura patent and further in view of the Takizawa patent, dependent

claims 5-7 are likewise not unpatentable over the Behrens patent in view of the Nakamura patent and further in view of the Takizawa patent.

In section 7 of the Office Action, the Examiner rejected claims 8 and 9 under 35 U.S.C. §103(a) as being unpatentable over the Behrens patent in view of the Nakamura patent and further in view of the Stolfus patent.

The Stolfus patent discloses in Figure 5 a vehicle speed sensor conditioning circuit 100. The circuit 100 includes a flip-flop, a binary counter 112, and a transistor 122. The a flip-flop is configured from a NAND gate 110 and circuit 108. A sensor output 124 is connected to the clock input of the circuit 108. The circuit 100 functions to divide a sensor output by 12 in order to improve the duty cycle output of a vehicle speed sensor circuit. The circuit 100 is generally configured to provide a particular number of pulses per distance of vehicle travel.

Figure 6 of the Stolfus patent depicts a flow chart having a block 202 at which the vehicle speed sensor circuit 100 provides a particular number of pulses per distance of vehicle travel. At block 204, the vehicle speed sensor circuit 100 is configured so that

the output of the speed sensor is divided by a particular value. At block 206, different values are placed on the parallel load pins of the binary counter 112 which permits the sensor output to be divided by placing different values on the parallel load pins. At block 208, a flip-flop is utilized to trigger on negative edges. Negative-edge spacing is thus independent of a sensor air gap, as indicated at block 210. The output of the circuit 100 is thus near 50% duty cycle as indicated at block 212.

There is no suggestion in the Stolfus patent that magnetoresistors can be used to sense the eddy currents generated by the blades of a compressor wheel passing by a permanent magnet. The Stolfus patent merely improved the duty cycle output from the vehicle speed sensor circuit.

Therefore, independent claim 1 is not unpatentable over the Behrens patent in view of the Nakamura patent and further in view of the Stolfus patent.

Because independent claim 1 is not unpatentable over the Behrens patent in view of the Nakamura patent and further in view of the Stolfus patent, dependent claims 8 and 9 are likewise not unpatentable over the

Behrens patent in view of the Nakamura patent and further in view of the Stolfus patent.

In section 8 of the Office Action, the Examiner rejected claims 10 and 11 under 35 U.S.C. §103(a) as being unpatentable over the Behrens patent in view of the Nakamura patent and further in view of the Stolfus patent and still further in view of the Cila patent.

As discussed above, there is no suggestion in the Nakamura patent, in the Stolfus patent, or in the Cila patent that magnetoresistors can be used to sense the eddy currents generated by the blades of a compressor wheel passing by a permanent magnet.

Therefore, independent claim 1 is not unpatentable over the Behrens patent in view of the Nakamura patent and further in view of the Stolfus patent and still further in view of the Cila patent.

Because independent claim 1 is not unpatentable over the Behrens patent in view of the Nakamura patent and further in view of the Stolfus patent and still further in view of the Cila patent, dependent claims 10 and 11 are likewise not unpatentable over the Behrens patent in view of the Nakamura patent and further in view of the Stolfus patent and still further in view of the Cila patent.

In section 9 of the Office Action, the Examiner rejected claims 12 and 13 under 35 U.S.C. §103(a) as being unpatentable over the Behrens patent in view of the Nakamura patent and further in view of the Stolfus patent and still further in view of the Takizawa patent.

As discussed above, there is no suggestion in the Nakamura patent, in the Stolfus patent, or in the Takizawa patent that magnetoresistors can be used to sense the eddy currents generated by the blades of a compressor wheel passing by a permanent magnet.

Therefore, independent claim 1 is not unpatentable over the Behrens patent in view of the Nakamura patent and further in view of the Stolfus patent and still further in view of the Takizawa patent.

Because independent claim 1 is not unpatentable over the Behrens patent in view of the Nakamura patent and further in view of the Stolfus patent and still further in view of the Takizawa patent, dependent claims 12 and 13 are likewise not unpatentable over the Behrens patent in view of the Nakamura patent and further in view of the Stolfus patent and still further in view of the Takizawa patent.

In section 10 of the Office Action, the Examiner rejected claims 14-18 and 25 under 35 U.S.C.

§103(a) as being unpatentable over the Behrens patent in view of the Takizawa patent.

Independent claim 14 is directed to an apparatus having a non-ferromagnetic compressor wheel of a turbocharger, a magnetic field sensor housing, a permanent magnet, and an active magnetic field sensor. The non-ferromagnetic compressor wheel has fins. The magnetic field sensor housing is attached to a structure in proximity to the non-ferromagnetic compressor wheel. The permanent magnet is disposed within the magnetic field sensor housing and is positioned so as to induce eddy currents on the fins. The active magnetic field sensor is disposed within the magnetic field sensor housing and is positioned with respect to the non-ferromagnetic compressor wheel and the permanent magnet so as to be magnetically biased by the permanent magnet and so as to sense a magnetic field induced by the eddy currents to thereby detect rotation of the non-ferromagnetic compressor wheel.

The Behrens patent does not disclose the use of an active magnetic field sensor that is magnetically biased by the permanent magnet and that senses rotation of the compressor wheel.

The Examiner essentially asserts that it would have been obvious to use the magnetic detection element 27 disclosed in the Takizawa patent in place of the induction coil 10 disclosed in the Behrens patent. However, the Examiner does not offer any argument as to why such a rearrangement of the apparatus disclosed in the Behrens patent would have been suggested to one of ordinary skill in the art.

Accordingly, the Examiner has not made out a prima facie case of obviousness with respect to independent claim 14. Therefore, independent claim 14 is not unpatentable over the Behrens patent in view of the Takizawa patent.

Moreover, there is no suggestion in either the Behrens patent or the Takizawa patent that magnetoresistors can be used to sense the eddy currents generated by the blades of a compressor wheel passing by a permanent magnet. The Behrens patent discloses the use of a coil to sense eddy currents, and the Takizawa patent discloses the use of the magnetic detection element 27 to sense the magnetic gear teeth of the encoder 13.

Therefore, for this reason also, independent claim 14 is not unpatentable over the Behrens patent in view of the Takizawa patent.

Because independent claim 14 is not unpatentable over the Behrens patent in view of the Takizawa patent, dependent claims 15-18 and 25 are likewise not unpatentable over the Behrens patent in view of the Takizawa patent.

In section 11 of the Office Action, the Examiner rejected claims 19-22 under 35 U.S.C. §103(a) as being unpatentable over the Behrens patent in view of the Takizawa patent and further in view of the Stolfus patent.

There is no suggestion in the Stolfus patent that an active magnetic field sensor can be used to sense the eddy currents generated by the blades of a compressor wheel passing by a permanent magnet. The Stolfus patent merely discloses improving the duty cycle output from a vehicle speed sensor circuit.

Therefore, independent claim 14 is not unpatentable over the Behrens patent in view of the Takizawa patent and further in view of the Stolfus patent.

Because independent claim 14 is not unpatentable over the Behrens patent in view of the Takizawa patent and further in view of the Stolfus patent, dependent claims 19-22 are likewise not

unpatentable over the Behrens patent in view of the Takizawa patent and further in view of the Stolfus patent.

In section 12 of the Office Action, the Examiner rejected claims 23 and 24 under 35 U.S.C. §103(a) as being unpatentable over the Behrens patent in view of the Takizawa patent and further in view of the Adelerhof patent.

The Adelerhof patent discloses an AMR sensor 3 located on the side of a soft magnetic target wheel 1 that is provided with teeth 5 about its circumference. A bias magnet 2 biases the sensor 3. The magnetic field emanating from the magnet 2 passes the sensor 3 in the direction towards a shaft 4 if the sensor is between two teeth, or the magnetic field is bent towards the target wheel 1 if the sensor 3 is next to a tooth. The change in field direction is sensed by the sensor 3.

As discussed above, there is no suggestion in either the Behrens patent or the Takizawa patent that an active magnetic sensor can be used to sense the eddy currents generated by the blades of a compressor wheel passing by a permanent magnet. The Behrens patent discloses the use of a coil to sense eddy currents, and

the Takizawa patent discloses the use of magnetoresistors to sense magnetic elements.

Similarly, there is no suggestion in the Adelerhof patent that magnetoresistors can be used to sense the eddy currents generated by the blades of a compressor wheel passing by a permanent magnet. The Adelerhof patent discloses the use of magnetoresistors to sense magnetic gear teeth.

Therefore, independent claim 14 is not unpatentable over the Behrens patent in view of the Takizawa patent and further in view of the Adelerhof patent.

Because independent claim 14 is not unpatentable over the Behrens patent in view of the Takizawa patent and further in view of the Adelerhof patent, dependent claims 23 and 24 are likewise not unpatentable over the Behrens patent in view of the Takizawa patent and further in view of the Adelerhof patent.

In section 13 of the Office Action, the Examiner rejected claims 26-32 and 35 under 35 U.S.C. §103(a) as being unpatentable over the Behrens patent in view of the Stolfus patent.

Independent claim 26 is directed to a method of sensing rotation of a non-ferromagnetic compressor wheel of a turbocharger comprising inducing eddy currents in fins of the non-ferromagnetic compressor wheel, sensing a magnetic field induced by the eddy currents by use of an active magnetic field sensor so as to produce pulses having a pulse rate dependent upon a speed at which the non-ferromagnetic compressor wheel rotates, and reducing the pulse rate so as to provide a consistent pulse rate regardless of the number of the fins of the non-ferromagnetic compressor wheel.

Neither the Behrens patent nor the Stolfus patent suggests reducing the pulse rate so as to provide a consistent pulse rate regardless of the number of the fins of the non-ferromagnetic compressor wheel.

Accordingly, the combination of the Behrens patent and the Stolfus patent does not suggest the invention of independent claim 26. Therefore, independent claim 26 is not unpatentable over the Behrens patent in view of the Stolfus patent.

Because independent claim 26 is not unpatentable over the Behrens patent in view of the Stolfus patent, dependent claims 27-32 and 35 are

likewise not unpatentable over the Behrens patent in view of the Stolfus patent.

In section 14 of the Office Action, the Examiner rejected claims 33 and 34 under 35 U.S.C. §103(a) as being unpatentable over the Behrens patent in view of the Stolfus patent and further in view of the Adelerhof patent.

The Adelerhof patent likewise does not suggest reducing the pulse rate so as to provide a consistent pulse rate regardless of the number of the fins of the non-ferromagnetic compressor wheel.

Accordingly, the combination of the Behrens patent, the Stolfus patent, and the Adelerhof patent does not suggest the invention of independent claim 26. Therefore, independent claim 26 is not unpatentable over the Behrens patent in view of the Stolfus patent and further in view of the Adelerhof patent.

Because independent claim 26 is not unpatentable over the Behrens patent in view of the Stolfus patent and further in view of the Adelerhof patent, dependent claims 33 and 34 are likewise not unpatentable over the Behrens patent in view of the Stolfus patent and further in view of the Adelerhof patent.

In section 15 of the Office Action, the Examiner rejected claim 36 under 35 U.S.C. §103(a) as being unpatentable over the Behrens patent in view of the Stolfus patent and further in view of the Durbin patent.

The Durbin patent discloses a centrifuge rotor 10 in which magnets 12a-f are imbedded. A magnetic detector 14 detects the passage of each of the magnets 12a-f as the rotor 10 makes one complete revolution. A comparator 24 compares the non-inverted output signal of the detector 14 to a positive threshold voltage to produce a north signal, and a comparator 26 compares the inverted output signal of the detector 14 to the positive threshold voltage to produce a south signal.

An exclusive-OR gate 28 combines the north and south signals from the comparators 24 and 26 to provide a digital tachometer signal. The tachometer signal produced by network 18 is applied to a counter 32 which converts the tachometer signal to a multi-bit digital word. This digital word is then periodically read by a microcomputer 50 which determines the difference between the actual and desired speed of the rotor 10.

According to the Examiner, the Durbin patent discloses a maximum speed reading at column 3, line 22,

at column 9, lines 62-68, at column 10, lines 1-9, and at column 10, lines 29-34.

Column 3, line 22 of the Durbin patent states that, because a Hall effect device is sensitive to the direction of the magnetic field to which it is exposed, its output can be used to distinguish a north-oriented magnet from a south-oriented magnet. As can be seen, there is no mention here of a maximum speed reading.

Column 9, lines 62-68 of the Durbin patent is the preamble of claim 6 which recites an apparatus for determining the actual speed and the maximum safe speed of a centrifugal rotor.

Column 10, lines 1-9 of the Durbin patent is a portion of claim 6 which recites a magnetic detector that is responsive to magnets for generating an output signal, a signal generating means responsive to the output signal for generating an actual speed signal indicative of the actual speed of the rotor, and a decoding means responsive to the output signal for decoding a code (determined by the north south orientations of the magnets) to determine the maximum safe speed of the rotor. In other words, the north south orientations of the magnets are used to encode the rotor with its maximum safe speed and this code is read by the decoder.

Column 10, lines 29-34 of the Durbin patent is claim 12 which recites that the decoding means includes a computer for storing the maximum safe speeds that are associated with each of a plurality of different codes, the computer being programmed to (i) read the code on a recurrent basis and (ii) determine the maximum safe speed that is associated with the read code.

As can be seen, the Durbin patent does not disclose sensing and storing an actual maximum compressor speed. Rather, the Durbin patent discloses reading a code off of the rotor that indicates the maximum speed specified from the rotor. The code is embedded in the rotor by the particular north-south pole arrangement of the magnets provided on the rotor.

Therefore, because the Behrens patent, the Stolfus patent, and the Durbin patent do not disclose storing an actual maximum compressor speed sensed by an active magnetic field sensor as required by dependent claim 36, dependent claim 36 is not unpatentable over the Behrens patent in view of the Stolfus patent and further in view of the Durbin patent.

Moreover, as discussed above, neither the Behrens patent nor the Stolfus patent suggests reducing the pulse rate so as to provide a consistent pulse rate

regardless of the number of the fins of the non-ferromagnetic compressor wheel as required by independent claim 26. Likewise, the Durbin patent fails to disclose reducing the pulse rate so as to provide a consistent pulse rate regardless of the number of the fins of the non-ferromagnetic compressor wheel.

Accordingly, the combination of the Behrens patent, the Stolfus patent, and the Durbin patent does not suggest the invention of independent claim 26. Therefore, independent claim 26 is not unpatentable over the Behrens patent in view of the Stolfus patent and further in view of the Durbin patent.

Because independent claim 26 is not unpatentable over the Behrens patent in view of the Stolfus patent and further in view of the Durbin patent, dependent claim 36 is likewise not unpatentable over the Behrens patent in view of the Stolfus patent and further in view of the Durbin patent.


CONCLUSION

In view of the above, it is clear that the claims of the present application are patentable over the references applied by the Examiner. Accordingly, allowance of these claims and issuance of the above captioned patent application are respectfully requested.

Respectfully submitted,

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